

**REMARKS**

Claims 1, 3, 7-9, 15, and 18-25 were pending in this application.

Applicants have amended Claims 1 and 3.

Applicants have added Claim 26.

Support for these amendments and added claim is replete throughout the application.

Applicants have cancelled without prejudice or disclaimer of that which is defined thereby Claims 18 and 20-25. Applicants' cancellation of these claims is with an eye on advancing prosecution on the merits and minimizing the issues that the Examiner needs to consider.

Accordingly, upon entry hereof, Claims 1, 3, 7-9, 15, 19, and 26 are now pending, with Claims 1 and 3 being presented in independent form.

Applicants turn now to the claim objections and rejections under 35 U.S.C. §§ 112, 102 and 103.

**Section 112 Rejections**

Claim 18 and 20-25 stand rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite for the reasons set forth at page 2 of the Action.

Applicants' cancellation of these claims renders moot the Section 112 rejection.

### **Section 103 Rejections**

Claims 1, 3, 7-9, 15, 18-19, and 20-25 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. Patent No. 6,677,179 (Yin et al.) ("the '179 patent") in view of U.S. Patent No. 6,156,132 (Yamashita et al.) ("the '132 patent") and further in view of U.S. Patent No. 6,197,253 (Broomfield et al.) ("the '253 patent").

Applicants' cancellation of Claims 18 and 20-25 renders moot the Section 103 rejections thereof. Applicants traverse the remaining Section 103 rejections.

Applicants provide for the Examiner's benefit the proper legal setting regarding the law on obviousness around which an application for Letters Patent of the United States must be examined.

To establish a *prima facie* case of obviousness, there must be some reason, either in the documents of record themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the documents or to combine cited teachings. *KSR International Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1741 (2007). Moreover, the cited document (or

documents when combined) must teach or suggest all the claim limitations. The reason to make the claimed combination, and a reasonable expectation of success, must be found elsewhere than in Applicants' disclosure, such as in the cited documents, the nature of the problem to be solved, or in the knowledge/understanding of the person of ordinary skill in the art. MPEP § 2143; *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Applicants submit that the instant Section 103 rejection fails to meet these requirements.

For the Examiner's convenience, Applicants set forth a brief review of the invention as presently claimed.

The present invention with reference to Claim 1 as amended is directed to and is defined by a lead free soldering material consisting essentially of Sn (tin), 10 wt.% or less Ag (silver), 10 wt.% or less Bi (bismuth), 1 to 3 wt.% Sb (antimony), 0.5 to 3 wt.% Cu (copper), and 1.0 wt.% or less Ni (nickel).

And the present invention with reference to Claim 3 as amended is directed to and is defined by a lead free soldering material consisting essentially of 2 to 10 wt.% Ag, Bi, 1 to 3 wt.% Sb, 0.5 to 3 wt.% Cu and 0.05 to 0.3 wt.% Ni, where the Sb:Bi wt.% ratio is from 1:1.5-3.

In addition, the present invention with reference to Claim 26 is directed to and is defined by a lead free soldering material consisting essentially of 2 to 10 wt. % Ag, 1 to 3 wt. % Bi, 1 to 3 wt. % Sb, 0.5 to 3 wt. % Cu and 0.05 to 0.3 wt. % Ni.

Against these claims, three patent documents have been cited in combination in the Action. The three patent documents are discussed and contrasted below.

The '179 patent is directed to a method for underfilling an electronic chip mounted on a substrate. The method of the '179 patent dispenses underfill on the substrate, dips the chip in a tacky thermosettable flux that does not contain filler to create a dipped chip, places the dipped chip on the substrate covered with underfill, solders the dipped chip to the substrate, and cures the underfill. The '179 patent discloses a solder alloy of 3.8% Ag and 0.7% Cu. Such a solder alloy is a high melting point solder, melting at around 217°C.

The '132 patent is directed to a lead-free solder alloy consisting essentially of in weight percent based on the total amount of the alloy composition  $30 \leq \text{Bi} \leq 58$ ;  $0 < \text{Ge} \leq 0.1$ ; and the balance Sn. Because of the high Bi content, the lead free solder alloy of the '132 patent is a low melting point alloy, melting at or around 138°C. A melting point so low would be

entirely inappropriate for commercial applications requiring higher melting points for the solder, such as a solder reflow process for semiconductor package and assembly applications, which is a commercial application the lead free solder material that is the subject of the pending claims. Additionally and significantly, the Bi content disclosed in the '132 patent far exceeds, by at least a factor of 3 or 4, that in the pending claims.

The '253 patent is directed to an alloy composition comprising (a) Sn; (b) Sb; (c) Bi; and (d) from about 0.5 to about 8% In, where the alloy is essentially free of Zn, Ni, Fe, Pb, Cd, and Al. Significantly, the sum of Cu and Ag in the alloy composition of the '253 patent does not exceed 0.5%, based on a total weight of the alloy.

The solder alloy disclosed in the '179 patent is devoid of elements beyond Ag and Cu (and of course Sn). The Examiner admits this deficiency and turns to the '132 patent and the '253 patent in an attempt to provide a remedy. The combination of these three patent documents is improper, has been performed with no motivation in any of the three documents to do so, would not lead to predictable results and has been done on the basis of a pick and choose hindsight perspective, without

regard (and indeed contrary) to the import of the teachings of each of the three patent documents.

The '132 patent refers to the addition of 0.5% Cu and 0.1% Ni to Sn43Bi57 for the purpose of improving creep deformation resistance (heat resistance). However, the '132 patent is silent as far as resistance to temperature cycling is concerned. Additionally and significantly the solder alloy of the '132 patent is a completely different one than the solder alloy disclosed in the '179 patent, melting at 138°C. Thus, one of ordinary skill in the art would not be lead from a high melting point alloy such as in the '179 patent to a low melting point alloy such as in the '132 patent.

It would not be an obvious design choice starting with a high melting point solder to look to additives from a low melting point solder, because the structure of the intermetallics formed at the different melting points are quite different in the two solder systems. The different structures lead to different physical properties. Thus, an approach that may be reasonable for a relatively high temperature, high tin content lead-free soldering, may be quite unreasonable for a low temperature eutectic tin-bismuth solder (as in the '132 patent). Indeed, it would not have been predictable that such a

counterintuitive approach would yield beneficial results, such as in terms of improved resistance to temperature cycling.

The '132 patent indicates that the effect of the addition of Ni by itself to the base SnBi alloys is not beneficial, but rather that Ni needs to be added with 0.5% Cu.

In addition, the solder alloy of the '179 patent is clearly incompatible with the teaching of the '253 patent, where the sum of copper and silver can not exceed 0.5%. As such these two patent documents should not have been combined in the first place.

Here, concluding as the Action has that the addition of Sb and Bi is obvious from the '253 patent where these metals are added to optimise casting properties (specifically mould filling) is erroneous since resistance to temperature cycling is not related in any way to ability to filling a mould. Mechanical properties are not related to casting properties, thus it cannot be obvious that the addition of metals to improve casting properties will improve mechanical properties. And the '253 patent discusses white metal casting alloys where cast shape, sharpness of profile are important. Neither soldering, wetting and bonding to substrates nor high temperature service conditions are discussed.

Moreover, use of the '253 patent ignores the transitional phrase used in the claims -- i.e., "consisting essentially of". MPEP § 2111.03 indicates that "[t]he transitional phrase 'consisting essentially of' limits the scope of a claim to the specified materials or steps 'and those that do not materially affect the basic and novel characteristic(s)' of the claimed invention."<sup>1</sup>

Certain elements are recited in Claim 1 using the transitional phrase "consisting essentially of". However, the use of the '253 patent in the Action ignores the fact that the alloy composition requires Sn, Sb, Bi, and In. In is not recited in the pending claims.

By picking and choosing only so much of each of the three cited patent documents to support the Section 103 rejection, the Action has modified the teachings of the references and destroyed the documents for what each fairly does teach. In addition, the application of the patent documents in the manner in which they have been applied also ignores the various performance potential of each disclosed alloy, and the fact that having differing performance potential one of ordinary

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<sup>1</sup> "A 'consisting essentially of' claim occupies a middle ground between closed claims that are written in a 'consisting of' format and fully open claims that are drafted in a 'comprising' format." *PPG Industries v. Guardian Industries*, 156 F.3d 1351, 1354, 48 USPQ2d 1351, 1353-54 (Fed. Cir. 1998).



skill in the art would not have looked to one or the other to reach the invention as now claimed.

For instance, an element addition that makes the alloy harder would not necessarily be of any help in making the alloy more resistant to thermal fatigue failure.

Further, it is not obvious to someone of ordinary skill in the art that what works for a low melting point (such as Bi-Sn) alloy would also work for a high melting point (such as Sn-Ag-Cu) alloy designed for service at a temperature at which the Bi-Sn alloy would be molten.

Accordingly, the combination of the cited patent documents, even if appropriate (which Applicants dispute) would not lead to predicable results. As such, no reasonable expectation of success would be expected.

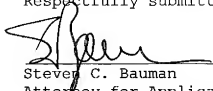
Based on the above, favorable reconsideration and consideration as the case may be is respectfully requested.

Having addressed and overcome each of the rejections advanced in the Action, prompt and favorable re-consideration of the subject application is respectfully requested.

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